Original Article

Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) Incident Reporting Study: Transfusion Error

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Background: The Royal College of Anesthesiologists of Thailand conducted a project named "The Perioperative and Anesthetic Adverse Events in Thailand (PAAd Thai) study" in 2015.

Objective: To determine the incidents, contributing factors, factors minimizing the incident, and suggested corrective strategies for blood transfusion error in "PAAd Thai study".

Materials and Methods: A prospective multicentered observational study was conducted in 22 participating hospitals across Thailand between January and December 2015. A report regarding the incident of perioperative blood transfusion errors was reviewed and discussed to reach a consensus agreement by three anesthesiologists. Descriptive statistics was used for analysis and report.

Results: Six incident reports met the criteria. Two patients received wrong A or B pack red cell (PRC), developed serious ABO incompatibility reaction (i.e., gross hematuria), and needed unplanned ICU admission. Another two patients received wrong O PRC but did not experience any reaction. The last two patients received the correct blood groups but with a wrong label in the blood tag and barcode. It was found that most of the incidents occurred during the duty shift of the anesthesia providers. The contributory factors were miscommunication and negligence in the patient identification before the blood transfusion.

Conclusion: Failure to follow practice guideline and miscommunication were major contributing factors. Factors minimizing incident were experience, vigilance, adequate equipment, and following the practice guideline. Suggested corrective strategies were clinical practice guideline, improve communication skill, more equipment, and a morbidity mortality conference. Anesthetists' non-technical skills (ANTS) may also be used to improve patient safety.

Keywords: Transfusion mismatch, Transfusion error, Communication, Practice guidelines, ABO incompatibility

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During operation, blood component is frequently transfused to the patient especially in major operation cases. Indication for blood transfusion therapy in operating room varies largely according to clinical condition of patients[1]. Transfusion of red cell products can transmit infectious agents and sometimes cause serious hemolytic transfusion reactions[1-3]. Transfusion mismatch is a preventable event. Therefore, the anesthetist have to find the strategies to prevent the incident.

In 2007, the Royal college of Anesthesiologists of Thailand organized the Thai Anesthesia Incidents Monitoring Study (Thai AIMS) to study anesthesia incidents from 51 hospitals in Thailand[4]. The incident of transfusion mismatch occurred in 0.1% of the total

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incident reports. In 2015, a nationwide study named the Peri-operative and Anesthetic Adverse Events in Thailand (PAAd Thai) was conducted to improve pre-operative care and patient safety in Thailand. Eight university and 14 non-university hospitals across Thailand reported the incidents for PAAd Thai study[5,6].

The present study was performed to identify the perioperative incidents of 24 hours transfusion mismatch among 2,206 incident reports from PAAd Thai Study and to determine the contributing factors, factors minimizing the incident, and suggested corrective strategies for transfusion mismatch.

Materials and Methods

The present report was part of the prospective multicentered observational study conducted in 22 participating hospitals across Thailand. Approved by the Royal college of Anesthesiologists of Thailand, the study was carried out between January and the end of December 2015. After the study was approved by the Ethical Committee from each of participating hospitals, the specific anesthesia related adverse events during anesthesia and 24 hours post-operative period were reported by anesthesiologists and nurse anesthetists on an anonymous and voluntary basis. After the occurrences or undesirable events occurred, the adverse events were reported by filling out a standardized incident reporting form as soon as possible. Adverse events included pulmonary aspiration, pulmonary embolism, esophageal intubation, endobronchial intubation, desaturation, re-intubation, difficult intubation, failed intubation, severe arrhythmia, total spinal block, awareness, coma, cerebrovascular accident (CVA), convulsion, nerve injuries, transfusion mismatch, suspected MI, myocardial ischemia, cardiac arrest, death, suspected malignant hyperthermia, anaphylaxis, anaphylactoid reaction, allergy, drug error, equipment malfunction or failure, and wrong patient, wrong operation site, wrong surgery, and suspected emergence delirium. Patient demographic characteristics, surgical information, anesthetic information, contributing factors, factors minimizing the incident, and suggested corrective strategies for each event were also reported.

Definition of transfusion mismatch is un-intentionally transfused wrong group of blood component or transfused to the wrong patient with or without adverse reaction.

The transfusion mismatch incident reports were reviewed by three independent anesthesiologists to identify mechanism of the incident, contributory factors, factors minimizing the incident, and suggested corrective strategies. Descriptive statistics was used for analysis and report.

Table 1. Demographic data, anesthetic technique, and type of surgery (n=6)

Variables	Number (%)
Age (year)	
<70	3 (50.00)
>70	3 (50.00)
Sex	
Male	4 (66.67)
Female	2 (33.33)
ASA physical status	
1	1 (16.67)
2	1 (16.67)
3	4 (66.67)
Incident	
Emergency	2 (33.33)
Elective	4 (66.67)
Main anesthetic technique	
General anesthesia	6 (100)
Type of surgery	
General surgery	3 (50.00)
Orthopedics surgery	1 (16.67)
Gynecological surgery	1 (16.67)
Otorhinolaryngological surgery	1 (16.67)

Results

After the 12-month period of the PAAd Thai Study, there were 2,206 incident reports with 3,028 critical incidents from 333,219 total anesthetic cases. Among these reports, seven incidents of transfusion mismatch were sent to three reviewers. One report was excluded from the study because it did not meet criteria for transfusion mismatch. The incident of transfusion mismatch occurred in 0.27% of the total incidents. Demographic data, anesthetic techniques, and types of surgery are shown in Table 1.

The incidents involved four male and two female patients, aged between 46 and 87 years old. Two incidents (33.33%) occurred in emergency cases, and the other four incidents (66.67%) occurred in elective cases. All of the incidents occurred in inpatient department (IPD) patients who received surgery under general anesthesia with orotracheal intubation. Three incidents (50%) occurred during general surgery,

Table 2. Locations, time when incident detected, and anesthesia performer and personnel who de-tected incident (n=6)

	Number (%)
Location	
Operating room	4 (66.67)
Recovery room	2 (33.33)
Time when incident detected	
Maintenance	4 (66.67)
Recovery	2 (33.33)
Anesthesia performer	
Nurse anesthetist	3 (50.00)
Anesthesia resident	2 (33.33)
Anesthesiologist	1 (16.67)
Personnel who detected the incident	
Nurse anesthetist	4 (66.67)
Anesthesia resident	1 (16.67)
Anesthesiologist	1 (16.67)

one incident (16.67%) in ENT surgery, one incident (16.67%) in orthopedics surgery, and one incident (16.67%) in gynecology surgery.

Four incidents (66.67%) occurred during the workday shift of the anesthesia personnel. Locations, time when incident detected, and anesthesia performers and personnel who detected incident are shown in Table 2.

Four incidents (66.67%) were found during maintenance period in the operating room, and two incidents (33.33%) occurred during the recovery phase in post-anesthesia care unit (PACU).

Two incidents (33.33%) occurred in the presence of the anesthesia resident, three incidents (50%) occurred in the presence of the nurse anesthetist, and one incident (16.67%) occurred in the presence of the anesthesiologist.

Four incidents (66.67%) of transfusion mismatch were detected by clinical diagnosis. The monitoring equipment could not detect the transfusion mismatch incident.

Two cases (33.33%) developed gross hematuria with unplanned intensive care unit (ICU) admission. The first case, during the operation, the anesthesia resident who worked under the anesthesiologist transfused packed red cells to a patient without patient identification. After 150 ml of packed red cells was transfused, the same resident found urticarial rash on face and chest wall of the patient and hematuria was also observed. Transfusion was stopped, the blood bag was re-checked, and the patient was re-identified. This patient was O blood group and was transfused with group A packed red cells. The second case, during the operation, the nurse anesthetist who worked in the morning shift told the anesthesia resident, who would work in the afternoon shift, that one unit of packed red cells had been warmed in water-bath in front of the operating room and ready for being transfused. Therefore, the anesthesia resident got one unit of packed red cells and transfused the blood without identifying the patient. After receiving 40 ml of packed red cells, gross hematuria was detected by the anesthesia resident. Transfusion was stopped immediately. The patient blood group and the blood bag were re-checked. This patient was O blood group and received group B packed red cells. In both patients, transfusion mismatch was clinically diagnosed, and they recovered completely after aggressive treatment with intravenous volume resuscitation, furosemide, dexamethasone, and chlorpheniramine.

In the other four cases, there were no immediate or long-term adverse outcomes after the transfusion errors. In the third case, the afternoon shift nurse anesthetist told the night shift nurse anesthetist that the surgeon had ordered to give one unit of packed red cells in water-bath to the patient who would be sent to the recovery room. About ten minute later, there was one patient sent to the recovery room. Therefore, the nurse anesthetist transfused that unit of pack red cells (PRCs) to that patient without identifying the patient. In fact, the patient who needed a blood transfusion was a patient who was transferred directly to ICU after the operation. Thirty minutes later, the ICU nurse called the nurse anesthetist and asked for the PRCs for that patient. The nurse anesthetist knew immediately that the PRCs was being transfused to the wrong patient. Transfusion was stopped and the PRCs and the patient name were re-checked. The patient was A blood group and received PRCs group O. In the fourth case, the nurse anesthetist brought the PRCs group O from the water-bath in front of the operating room and transfused it to patient in the operating room after checking the blood tag and blood bag but without identifying the patient. This patient was B blood group. In the fifth case, the patient was A blood group and was transfused PRCs group O by the nurse anesthetist without identifying the patient. There were no adverse outcomes in these three cases. In the sixth case, one unit of PRCs transfusion was made after the blood tag and blood bag were checked and the patient identification was done completely and correctly. The

Table 3. Summary of transfusion error (n=6)

Case No.	Age	Sex	ASA	Emergency/ elective	Location	Detection	Patient identification before transfusion	Blood group	Transfused blood group	Outcome
1	53	Female	2	Emergency	OR	Urticaria after transfusion	No	O	A	Gross hematuria, thrombocytopemia, complete recovery
2	46	Female	3	Elective	OR	Gross hematuria After 40 ml of blood transfusion	No	O	B	Gross hematuria, complete recovery
3	87	Male	3	Emergency	PACU	He was a wrong patient detected 30 minutes later after the blood transfusion (see details in text)	No	A	O	No adverse reaction found
4	81	Male	3	Emergency	OR	A missing warm blood (group O) prepared for another patient was found later to be transfused to this patient	No	B	O	No adverse reaction found
5	72	Male	3	Elective	OR	After transfusion it was found that there was an incorrect recipient name on the blood tag	No? or improper	O	O	No adverse reaction found
6	54	Male	1	Emergency	PACU	After transfusion, it was found that the barcode of the blood bag did not match with the patient's name	Yes	?	?	No adverse reaction found

OR=operating room; PACU=post-anesthesia care unit

Table 4. Contributing factors, factors minimizing incidents and suggested corrective strategies for transfusion mismatch (n=6)

	Number (%)
Contributing factors	
Mis-judgement	1 (16.67)
Haste	1 (16.67)
Miscommunication	4 (66.67)
Lack of blood wormer equipments	1 (16.67)
Blood bank problem	1 (16.67)
Other (do not follow blood transfusion guideline)	5 (83.33)
Factor minimizing incident	
Experience	1 (16.67)
Vigilance	5 (83.33)
Adequate equipment	1 (16.67)
Follow practice guideline	5 (83.33)
Other	1 (16.67)
Suggested corrective strategies	
Practice guideline	5 (83.33)
Improve communication skill	4 (66.67)
More equipment	1 (16.67)
Morbidity mortality conference	5 (83.33)

transfusion was done uneventfully. At this hospital, after each unit of PRCs was completely transfused, the nurse anesthetist had to notify the blood bank using the scan barcode on the blood bag. In this case, the nurse anesthetist found that the barcode and the patient's name did not match. The blood bank confirmed that matching process was correct for the patient, but there was an error in the barcode labeling process. Details of the six cases are summarized in Table 3.

Patient sign in, anesthetic checklists, time out, and sign out were performed in all transfusion mismatching incident cases.

Three anesthesiologists reviewed the transfusion mismatch incident reports and made conclusion that the incidents of transfusion mismatch detected by the clinical diagnosis could not be prevented by the surgical checklists. However, the six incidents (100%) were considered as preventable. Five incidents (83.33%) were considered to be ruled-base error and one incident (16.67%) was considered to be computer system error. Contributing factors, factors minimizing incidents, and suggested corrective strategies for transfusion mismatch are shown in Table 4.

Discussion

Transfusion mismatch are not common but can cause significant morbidity and mortality. The

occurrence of transfusion mismatch in the present study was 0.27% of all the incidents reported in the study period. In 2007, the Thai AIMS reported the occurrence of transfusion mismatch at about 0.1% of the total incident reports[4]. While the Thai AIMS data collection was only six months, in the present study, the data collection was over a 12-months period. This may explain the higher incidents reported in the present study.

The United Kingdom data from the Serious Hazards of Transfusion (SHOT) reports showed that in 2015, the number of transfusion error reports was 15.4 per 10,000 components issued by the U.K. blood service. There were 280 "incorrect blood component transfused" (IBCT) reports, and among these, there were 82 "wrong components transfused" (WCT) reports[7]. The present study did not collect total number of blood components transfused and blood components issued by blood bank from the participating hospitals. The incidents were reported only from the anesthesia department. Therefore, the present study reported only the number of transfusion mismatch incidents during the study period.

Signs and symptom of transfusion mismatch include fever, back pain, hemoglobinuria, hemoglobinemia, renal failure, disseminated intravascular coagulation (DIC), hypotension, and shock. In anesthetized patient, it was difficult to detect the signs and symptoms. In the present study, monitoring equipment could not the detect transfusion mismatch. The diagnosis of transfusion mismatch in the present study was made by clinical events only. Clinical manifestation of transfusion mismatch in the present study was hemoglobinuria. Janatpour et al also found that symptoms related to acute hemolysis such as mild to moderate hypotension, hemoglobinuria, or hemoglobinemia were most frequent[8]. Sahu et al also reported that in anesthetized patients' hemoglobinuria or diffuse bleeding (DIC) may be the only sign of acute intravascular red cell hemolysis with possibility of other causes to be ruled out[9].

In term of immediate outcome, severe transfusion reaction most often caused by ABO incompatibility and only a few millimeters of transfused blood can cause severe reaction[10]. A study from a tertiary care hospital from New Delhi, India reported that transfusion reaction was 0.19%, and hemolytic transfusion reaction was 1.27% of overall reactions. Most hemolytic reaction cases were due to major ABO-mismatched blood transfusion event[11]. In SHOT report, hemolysis contributed to death in five cases including one caused by anti-Wra (Wright antigen), one ABO incompatible transfusion, and an infant died related to exchange transfusion for D-related hemolytic disease of the fetus and newborn[7]. Two incident reports (33.33%) developed hemolytic transfusion reaction in the present study were also due to major ABO-mismatching. Fortunately, after intensive management both patients recovered completely without any sequelae.

The present study also found that 66.67% of incidents of transfusion mismatch reports occurred after changing anesthesia personnel from one work shift to another and miscommunication played major role in the incidents. These incidents were 100% preventable and most of the incidents reports considered to be ruled-base human error. After data exploration the authors found the cause of transfusion mismatch was that the anesthesia performers did not identified the patient before transfusing the blood component. Other studies also reported the most frequent error leading to transfusion of ABO-incompatible blood was failure of the final patient identification check at the bedside, leading to transfusion of properly labeled blood to a recipient other than the one intended[12,13]. Human error leading to the transfusion mismatch is a major source of transfusion-related fatalities[13,14,16].

In the present study, common factors contributing to transfusion mismatch incident were mis-judgement, haste, miscommunication, lack of blood warmer equipment, blood bank problem, and other factors such as not following blood transfusion guideline. Failure to follow practice guideline and miscommunication were major contributing factor for the incident. Lack of blood warmer equipment in each of operating room is a problem in many hospitals in Thailand. In this situation anesthesia personnel had to used central blood warmer located outside each of the operating room and this may lead to transfusion mismatch. Factors minimizing incident were experience, vigilance, adequate equipment, and following practice guideline. Suggested corrective strategies were clinical practice guideline, improve communication skill, more equipment, and morbidity mortality conference.

SHOT was established as a confidential reporting system for significant transfusion-related events, building an evidence base to support blood safety policy decisions, clinical guidelines, clinician education, and improvements in transfusion practice[15]. Application of new technology such as barcodes and radio-frequency identification technology for sample labelling and the bedside check, computerized order

entry and decision support systems will improve quality of transfusion therapy[16].

Non-technical skills can be defined as 'the cognitive, social, and personal resource skills' that complement technical skills, and contribute to safe and efficient task performance[17]. Recently non-technical skills was introduced for anesthesia. In term of anesthetists' non-technical skills (ANTS), there are four key skills categories taxonomy that include situation awareness, decision-making, team working and leadership, and task management (including stress and fatigue). In the present study, the authors found that failure to follow practice guideline and miscommunication were the major contributing factors for transfusion mismatch. Providing and maintaining standard are the element in task management. Coordinating activities with team members and exchanging information are elements in team working. Anticipating is an element in situation awareness[18]. Before transfused blood component to patient, anesthesia personnel should follow ANTS as guidance to improve patient safety and reduce human error.

Conclusion

Transfusion mismatch incident in Thailand needs to be monitored and the transfusion guideline must be launched to improve transfusion service. This serious incident does not occur only in the operating room but can occur everywhere the transfusion take place. To reduce transfusion mismatch incident, anesthesia personnel must improve communication skill when changing anesthesia personnel from one work shift to another, strictly following the blood transfusion guideline, and identify the patient before transfusion. ANTS is also important in term of improving patient safety.

What is already known on this topic?

Blood or blood components is frequently transfused to patients receiving major surgery. Transfusion may cause infection, hemolytic transfusion reaction. Practice guidelines are suggested as an important preventive strategy.

What this study adds?

The incidence of perioperative transfusion error was rare. Most errors were human factor, particularly failure to comply to the clinical practice guidelines (double check) and miscommunication. Training of ANTS improve perioperative patient safety.

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Conflicts of interest

The authors declare no conflict of interest.

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